OPERATING INSTRUCTIONS

TYPE 1652-A

RESISTANCE LIMIT BRIDGE

GENERAL RADIO COMPANY

760-E

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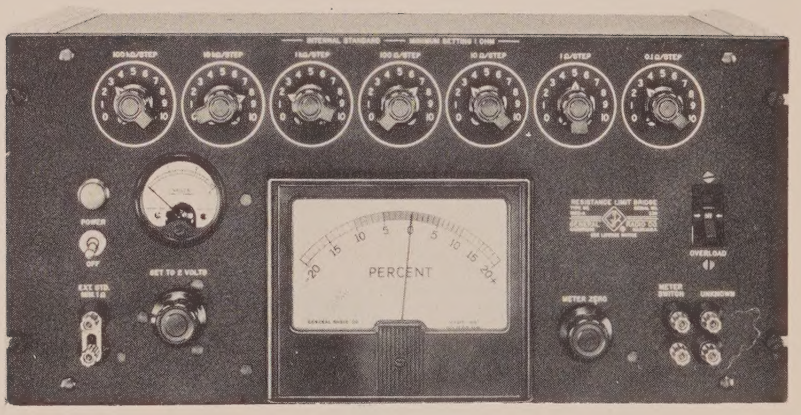
RESISTANCE LIMIT BRIDGE

Form 760-E
July, 1960

GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS, USA



Panel View of Type 1652-A Resistance Limit Bridge

SPECIFICATIONS

Resistance Range: As a limit bridge, 1 ohm to 1,111,111 ohms, with internal standard; for null measurement, 1 ohm to 1,111,111 ohms with internal standard; 1 ohm to 2 megohms with external standard.

Limit Range: Meter reads from -20% to +20%, with the standard RTMA tolerance ranges of ±5% and ±10% clearly indicated by appropriate coloring.

Accuracy: As a limit bridge, ±0.5% or better; for matching, ±0.2%; for null measurement, with internal standard, ±0.25% above 10 ohms and ±0.4% between 1 ohm and 10 ohms; with an external standard, from 1 ohm to 2 megohms ±(0.2% + accuracy of standard).

Voltage Applied to Unknown: The voltage across the unknown resistor is exactly one volt when the meter indication is zero. As the meter indication varies from -20% to +20% the voltage across the unknown will vary from 0.89 volt to 1.10 volts.

Power Supply: 105 to 125 volts or 210 to 250 volts, 60 cycles. The power input is approximately 30 watts.

Accessories Supplied: A line connector cord and spare fuses are supplied with the instrument.

Vacuum Tubes: One Type 6X4 and two Type 6SU7-GTY's. All are supplied with the instrument.

Mounting: The bridge is supplied mounted in a metal cabinet with black wrinkle finish. The cabinet need not be removed for relay-rack mounting of the bridge.

Dimensions: Overall, (width) 19 inches x (height) 8-3/4 inches x (depth behind panel) 10-1/2 inches.

Net Weight: 29 pounds.

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CAUTION! REMOVE PROTECTIVE WIRE SHUNT FROM TERMINALS OF LARGE METER BEFORE USING.

OPERATING INSTRUCTIONS

for

TYPE 1652-A

RESISTANCE LIMIT BRIDGE

SECTION 1.0 DESCRIPTION

1.1 GENERAL DESCRIPTION

The resistance limit bridge is intended primarily for production and inspection testing of resistors. It can be used to indicate on a meter the percentage deviation from an internal standard, to match pairs of resistors, and to compare resistors to a standard sample. It can also be used as a precision bridge for general resistance measurements by the null method.

1.2 CIRCUIT

The Type 1652-A Resistance Limit Bridge uses the conventional equal-arm Wheatstone Bridge circuit. The bridge is supplied by a constant-voltage d-c source, and its output is measured by a vacuum-tube voltmeter calibrated in the percentage difference between the unknown and standard resistors over a range of $\pm 20\%$.

The built-in standard resistor consists of seven Type 510 Decade Resistors and is adjustable in 0.1-ohm steps up to 1,111,111 ohms. An overload relay is adjusted to provide protection for the standard resistor against burn-out.

SECTION 2.0 OPERATION

2.1 POWER SUPPLY REQUIREMENTS

The power line voltage and frequency are indicated on the plate located near the power input receptacle. The frequency is 60 cycles and the voltage is either 105 to 125 volts or 210 to 250 volts. The bridge has internal voltage regulator. Total power is about 30 watts.

If it is desired to change the input voltage from one range to the other, change the power transformer connections as shown on the wiring diagram,

reverse the power-line label to indicate the proper line voltage and change the fuses (at the rear of the cabinet) to the proper rating (0.3 ampere Slow Blow 3AG fuses for 105- to 125-volt operation or 0.15 ampere Slow Blow 3AG fuses for 210- to 250-volt operation).

2.2 USE AS A RESISTANCE LIMIT BRIDGE

2.21 Allow a few minutes for the bridge to warm up after turning POWER on. Adjust INTERNAL STANDARD to value of resistance to be measured. Plug resistor into UNKNOWN binding posts. Short circuit METER SWITCH terminals and turn OVERLOAD relay ON. Adjust the SET TO 2 VOLTS knob until small meter reads 2 volts. Adjust METER ZERO. Remove short circuit from METER SWITCH terminals and read PERCENT error on meter.

2.22 During operation of the bridge the METER ZERO will occasionally have to be reset. To do this the METER SWITCH terminals must be short-circuited. For production inspecting therefore, it is convenient to construct a a jig that will automatically short the METER SWITCH terminals each time the resistor under test is removed. This can be done with a "micro-switch" that normally short-circuits the METER SWITCH terminals, but which opens when a resistor is placed in the jig. With such a device the operator has a continuous check on the zero of the bridge.

2.23 If it is desired to compare resistors to an external standard or to an acceptable sample, remove the short-circuiting link from the EXT. STD. binding posts and set the INTERNAL STANDARD to zero. Connect the external standard or sample resistor to the EXT. STD. binding posts and proceed as in Paragraph 2.21.

2.3 MEASUREMENTS BY THE NULL METHOD

Proceed as in Paragraph 2.21. Then adjust standard resistor until meter reads zero. Check zero by short-circuiting METER SWITCH terminals. If meter pointer does not move, read value of resistor from the standard resistor decade.

2.4 MEASUREMENT OF RESISTORS LESS THAN 5 OHMS

When measuring below 5 ohms, the resistance of ordinary leads and contacts becomes an appreciable fraction of the resistance being measured. It is therefore necessary to make all connections to the bridge with low resistance leads. Number 12 copper wire is adequate if the total length of leads to the resistor being measured is less than 10 feet. Even this amount of lead resistance must be compensated for in order to obtain accurate readings. To do this, replace the short-circuiting link on the EXT. STD. binding posts with an equal length of the same leads used on the unknown resistor. This compensation can, of course, be left on the bridge when measuring higher values of resistance.

2.5 MEASUREMENTS OF RESISTORS GREATER THAN 2 MEGOHMS

Above a few megohms the grid current drawn through the Wheatstone bridge by the vacuum-tube voltmeter will affect the normal operation of the bridge. However, it is still possible to measure resistors by the null method, providing the following procedure is followed.

Connect standard to EXT. STD. binding posts and set INTERNAL STANDARD to zero. Connect resistor to be measured to UNKNOWN terminals. Throw OVERLOAD relay OFF and adjust meter to zero with METER ZERO. Turn OVERLOAD relay ON and adjust EXT. STD. until meter reads zero. Repeat until meter does not move as OVERLOAD relay is turned ON and OFF. The value of standard resistance now equals the unknown resistor.

SECTION 3.0 MAINTENANCE AND SERVICE

GENERAL. The two-year warranty given with every General Radio instrument attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible.

In case of difficulties that cannot be eliminated by the use of these service instructions, please write or phone our Service Department, giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest district office (see back cover), requesting a Returned Material Tag. Use of this tag will insure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

3.1 MAINTENANCE

If one or more of the decade standard switches is not used for a long period of time it may develop a high contact resistance. This will affect the accuracy of the internal standard for settings below 5 ohms. To clean these contacts rotate the switches over all ten positions several times. Note that all seven of the decades must be cleaned in this manner since they are all in the circuit even when set to zero.

3.2 SERVICE

Table I gives a list of normal voltages for several points in the circuit. Many of the measurements in the voltmeter circuit must be made with a voltmeter having greater than 100 megohms input impedance, such as the General Radio Type 1800 Vacuum-Tube Voltmeter. (See page 4 for Table I.)

3.3 METER ZERO ADJUSTMENT

As tubes age it may become impossible to set zero with the panel adjustment provided. A second, internal adjustment is also provided (R-14). With the METER ZERO potentiometer set to the mid-point of its range, readjust R-14 to zero the meter.

3.4 CALIBRATION ADJUSTMENT

The adjustable resistor R-5 is provided to adjust the sensitivity of the meter. This is a factory adjustment and should not ordinarily be touched.

If readjustment is required for any reason, recalibration can be made in terms of the precision decade resistors of the bridge. An accurate 20% unbalance can be established for calibration purposes by connecting a resistor (say 10,000 ohms) to the bridge, balancing the bridge, and then offsetting the internal standard by the required amount.

TABLE I

RESISTANCE LIMIT BRIDGE SERVICE DATA

Measurements made with METER SWITCH terminals shorted, UNKNOWN terminals open, and METER ZERO adjustment control set. A-C measurements, voltmeter resistance = 1000 ohms per volt. D-C measurements, voltmeter resistance = 20,000 ohms per volt. D-C measurements marked (*) made with Vacuum-Tube Voltmeter GR Type 1800 (open grid connection).

V-1 Type 6X4 Rectifier

#1 to chassis	185	V.A.C.
#3 to #4	6.0	V.A.C.
#6 to chassis	185	V.A.C.
#7 to chassis	170	V.D.C.

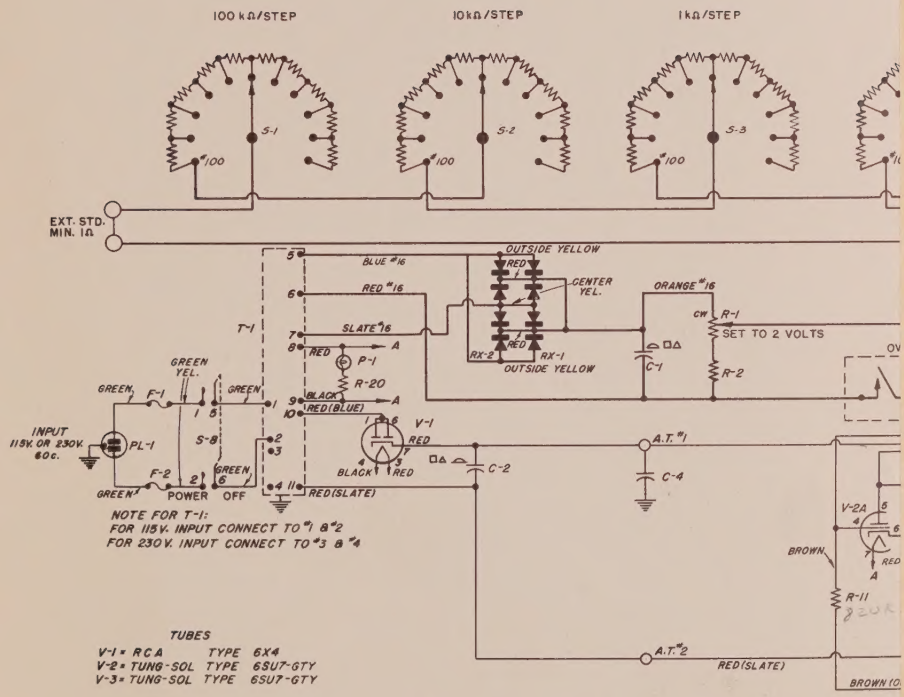
V-2 Type 6SU7-GTY Voltmeter Amplifier

#1 to #3	-1.5	V.D.C. *
#2 to #3	102	V.D.C. *
#3 to chassis	-101	V.D.C. *
#4 to #6	-1.5	V.D.C. *
#5 to #6	102	V.D.C. *
#6 to chassis	-101	V.D.C. *
#7 to #8	6.0	V.A.C.

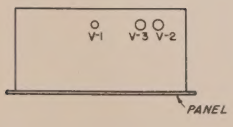
V-3 Type 6SU7-GTY Voltmeter Amplifier

#1 to #3	-1.2	V.D.C. *
#2 to #3	83	V.D.C. *
#3 to chassis	1.2	V.D.C. *
#4 to #6	-1.2	V.D.C. *
#5 to #6	83	V.D.C. *
#6 to chassis	1.2	V.D.C.*
#7 to #8	6.0	V.A.C.

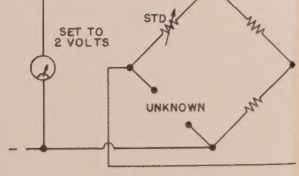
Voltage across C-2	340 V.D.C.
Total power	30 w.



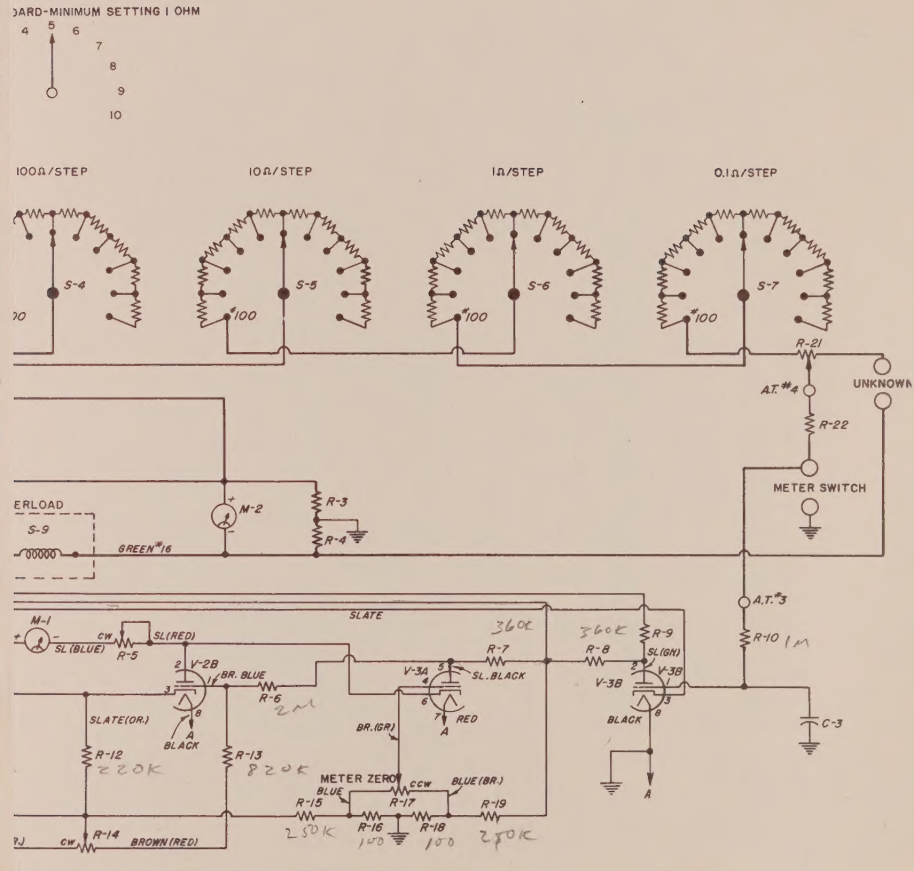
WIRING DIAGRAM FOR 16



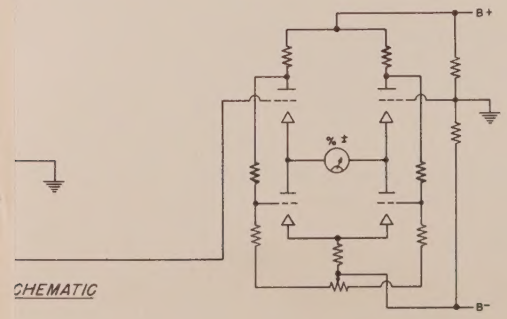
TUBE LAYOUT



ELEMENTARY S



52-A RESISTANCE LIMIT BRIDGE



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